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Weed-Initiated Pest Risk Assessment: Guidelines for Qualitative Assessments

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We welcome your opinion about this document, a work in progress. Please send your comments and suggestions to Polly Lehtonen, Botanist, USDA, APHIS, PPQ, Unit 133, 4700 River Road, Riverdale, MD 20737-1236.

Introduction

The Federal Noxious Weed Act (FNWA) of 1974 requires the Animal and Plant Health Inspection Service (APHIS) to list in the regulations those plant species officially designated as noxious weeds. Since 1974, APHIS has listed 94 weeds, relying mostly on recommendations from the former Technical Committee to Evaluate Noxious Weeds. In 1994, APHIS developed a weed policy which states, "APHIS will use risk assessments as a basis for weed exclusion decisions." In line with the APHIS Weed Policy, this document presents guidelines for conducting pest-initiated, qualitative pest risk assessments specifically for determining whether or not a weed species should be listed in (or delisted from) the FNWA regulations.

In a qualitative assessment we estimate risk in terms such as high or low as opposed to numerical terms such as probabilities or frequencies. Plant Protection and Quarantine (PPQ) risk assessment procedures are harmonized with those of the North American Plant Protection Organization (NAPPO) and the International Plant Protection Convention (IPPC) of the United Nations Food and Agriculture Organization (FAO). Our use of biological and phytosanitary terms (e.g., introduction, quarantine pest) conforms with the *NAPPO Compendium of Phytosanitary Terms* (NAPPO 1995) and the *Definitions and Abbreviations* (Introduction Section) in *International Standards for Phytosanitary Measures, Section 1_Import Regulations: Guidelines for Pest Risk Analysis* (FAO 1995).

Pest risk assessment is a component of pest risk analysis. FAO (1995) guidelines describe three stages in pest risk analysis:

Stage 1: Initiating the process by identifying a pest that may qualify as a quarantine pest, and/or pathways that may allow introduction or spread of a quarantine pest.

- Stage 2: Assessing pest risk (determining which pests are quarantine pests, characterized in terms of likelihood of entry, establishment, spread, and economic importance).
- Stage 3: Managing pest risk (developing, evaluating, comparing, and selecting options for dealing with the risk).

SUMMARY OUTLINE

This document provides a template for conducting FAO stages 1 and 2. APHIS completes eight basic steps in weed-initiated plant pest risk assessments:

Stage 1 (FAO): Initiating Pest Risk Analysis (PRA) Process

- Step 1. Document the Initiating Event(s) for the PRA.
- Step 2. Identify and Cite Previous Risk Assessments.
- Step 3. Establish Identity of Weed.

Stage 2 (FAO): Assessing pest risk

- Step 4. Verify Quarantine Pest Status: Geographic and Regulatory Criteria.
- Step 5. Assess Economic and Environmental Importance: Consequences of Introduction.
- Step 6. Assess Likelihood of Introduction.
- Step 7. Conclusion / Pest Risk Potential (PRP) of Weed.
- Step 8. Document the PRA. Cite references.

Methods: Pest Risk Assessment Guidelines

This section provides instructions for preparing the pest risk assessment.

Stage 1: Initiating Pest Risk Analysis Process

Step 1. Document the Initiating Event(s) for the Pest Risk Assessment

Document the reason(s) for initiating the weed-initiated pest risk assessment. A new or revised pest risk assessment for a specific weed will be required in the following situations (including, but not limited to):

- discovery of an established infestation or an outbreak of a new weed
- through research, identification of a new weed risk
- proposal from outside APHIS for listing a new weed under the Federal Noxious Weed Act
- proposal for delisting a weed already on the list.

Step 2. Identify and Cite Previous Risk Assessments.

Identify previous pest risk assessments for the same weed or a close relative. If an existing document adequately assesses the risks in question, determine if it is entirely or partly valid. If a previous assessment is entirely valid, **the risk assessment stops here.**

Step 3. Establish Identity of Weed

Define the weed as a taxon that can be adequately distinguished from other taxa of the same rank. Include:

Scientific Name: Order, Family, Genus, and species. (If weed cannot be clearly distinguished from other taxa of the same rank, **the assessment stops here.**)

Common name(s)

Limited pertinent information regarding:weed biology (e.g., weed/commodity association, life history, climatic tolerance,) and native distribution.

Stage 2: Assessing Pest Risk

Step 4. Verify Quarantine Pest Status: Regulatory and Geographic Criteria

Determine whether or not the weed satisfies regulatory and geographic criteria as a quarantine pest.

Regulatory: APHIS accepts the FAO (1995) and NAPPO (1995) definition of a quarantine pest as one having potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled. If a weed is present but not widely distributed, identify local, state, and federal control efforts. Recommendations for official control may be addressed in the conclusion (Step 7) at the end of the risk assessment.

APHIS must also consider the definition of noxious weed in the Federal Noxious Weed Act of 1974 (FNWA). The FNWA defines noxious weed as _any living stage (including but not limited to, seeds and reproductive parts) of any parasitic or other plant of a kind, or subdivision of a kind, which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants, livestock, or poultry or other interests of agriculture, including irrigation, or navigation, or the fish or wildlife resources of the United States or the public health._

Geographic: The weed-initiated risk assessment should first establish that the weed satisfies the geographic criteria. Describe the history of introduction and the weed_s current distribution in the United States. If the weed has reached the limits of its ecological range (i.e., is widely distributed), then the weed does not satisfy the definition of a federal noxious weed or quarantine pest and **the pest risk assessment stops here.** If the weed is determined to be a native species, then the weed does not meet the FNWA definition of noxious weed or the FAO definition of a quarantine pest and **the pest risk assessment stops here.**

Step 5. Assess Economic and Environmental Importance: Consequences of Introduction.

Estimate the economic and environmental consequences of introduction, considering _ . . . the establishment, spread and economic importance potential in the PRA area_ (FAO, 1995).

The weed-initiated risk assessment should establish that the weed is of potential economic importance by considering the consequences and likelihood of introduction. In qualitative pest risk assessments, we use six Risk Elements (RE) to estimate risk. RE #1-5 focus on the consequences of introduction and RE # 6 focuses on the likelihood of introduction.

Rate the potential consequences of introduction according to RE #1-5. These elements reflect the biology of the weed and its hosts. Rate each RE, from highest (3) to lowest (1). Discuss the rationale for each rating; cite references.

RE #1: Habitat Suitability

A weed may behave in its area of introduction as it does in its native area if climatic conditions are similar. For this element, we base estimates on suitable climate conditions. For a parasitic weed, the evaluation also considers the availability of host material. To rate this RE, use the U.S. "plant hardiness zones" as described by the U.S. Department of Agriculture (USDA, 1990).

Assign rating as follows:

Suitable climate and host plants would permit the weed to establish:		
Rating	Numerical Score	Explanation
High	3	In four or more plant hardiness zones
Medium	2	In two or three plant hardiness zones.
Low	1	In at most a single plant hardiness zone.

If the quarantine weed cannot become established in the PRA area because of unsuitable climate (and hosts, if the weed is a parasite), **the pest risk assessment stops here.**

RE #2: Agricultural Damage Potential

The risk posed by a plant pest depends on its ability to negatively affect plants, plant products, livestock, or other useful plants. For parasitic plants, we assume risk is correlated positively with host range. For nonparasitic weeds, risk is correlated with the number of crops, plant products, types of livestock, or other useful plants affected.

Assign rating as follows:

Rating	Numerical score	Explanation
High	3	Weed affects four or more species of agricultural plants and/or animals.
Medium	2	Weed affects two or three species of agricultural plants and/or animals.
Low	1	Weed affects only a single species of agricultural plant or animal.
Nil	0	Weed does not affect any species of agricultural plant or animal.

RE #3: Dispersal Potential

A newly introduced weed may reproduce and disperse. Consider the following biological factors:

reproductive patterns in the weed (e.g., reproductive output).

dispersal capability of the weed.

facilitation of dispersal by natural factors (e.g., wind, water, presence of vectors).

facilitation of dispersal by human factors (e.g., as ornamentals, spices, food, etc.).

Assign rating as follows:

Rating	Numerical score	Explanation
High	3	Weed has high reproductive potential (e.g., prolific seed production, high germination rate, reproduction by rhizomes, tubers, vegetative fragments, or stolons) AND highly mobile propagules (<i>i.e.</i> , capable of moving long distances aided by wind, water or vectors.)
Medium	2	Weed has either high reproductive potential OR highly mobile propagules.
Low	1	Weed has neither high reproductive potential nor highly mobile propagules.

Alternate method for RE #3

List characteristics which may influence a species' ability to reproduce and disperse. Assign a point for each characteristic the species has. For example:

Prolific seed production

Small seed size (less than 2.0 mm in length)

Rapid growth to reproductive maturity

High germination rate in a wide range of conditions

Allelopathy

Reproduction by rhizomes, tubers, turions, vegetative fragmentation or stolons (a point for each)

Seed dormancy

Stress tolerance

Lack of natural control agents

Well-developed storage tissue (e.g., tap root)

Dispersal by wind, water, animals (a point for each)

Dispersal by human activity

(Rank H(3), M(2), or L(1) based on number of characteristics: High =5 or more, medium = 3 or 4, low =1-2.)

RE #4: Economic Impact

Introduced weeds can cause a variety of economic impacts. We divide these impacts into three primary categories (other types of impacts may occur):

1. Reduced crop yield (e.g., by parasitism, competition, or by harboring other pests).

2. Lower commodity value (e.g., by increasing costs of production, lowering market price, or a combination); or if not an agricultural weed, by increasing costs of control.
3. Loss of markets (foreign or domestic) due to presence of a new quarantine pest.

Assign ratings as follows:

Rating	Numerical score	Explanation
High	3	Weed causes all three of the above impacts.
Medium	2	Weed causes any two of the above impacts.
Low	1	Weed causes any one of the above impacts.
Nil	0	Weed causes none of the above impacts.

RE #5: Environmental Impact

Consider whether or not the weed, if introduced, could:

1. Cause impacts on ecosystem processes (alteration of hydrology, sedimentation rates, a fire regime, nutrient regimes).
2. Cause impacts on natural community composition (e.g., reduces biodiversity, affects native populations, affects endangered or threatened species.)
3. Cause impacts on community structure (e.g., changes density of a layer, covers canopy, eliminates or creates a layer).
4. Have impacts on human health such as allergies or changes in air or water quality.
5. Have sociological impacts on recreation patterns and aesthetic or property values.
6. Stimulate control programs including toxic chemical pesticides or introduction of a nonindigenous biological control agent.

Assign ratings as follows:

Rating	Numerical Score	Explanation
High	3	Three or more of the above.
Medium	2	Two of the above.
Low	1	One of the above.
Nil	0	None of the above.

ECONOMIC and ENVIRONMENTAL IMPORTANCE SUMMARY: Consequences of Introduction: Cumulative Risk Element Score

Add together the numerical estimates for the five REs to produce an overall estimate of the Consequences of Introduction Risk Rating for the weed. The overall risk rating is used to assign a Consequences of Introduction Risk Score as follows:

Table 1. Risk: Consequences of Introduction (Sum RE #1-5)		
Cumulative Risk Element Score	Risk Rating	Risk Score
2 - 7	Low	1
8 - 11	Medium	2
12 - 15	High	3

The Consequences of Introduction Risk Rating is an indicator of the potential of the weed to become established and spread, and its potential to cause economic and environmental impacts.

Step 6. Assess Likelihood of Introduction/Spread

The final stage is an assessment of introduction and spread potential, which depends on the number of pathways from the exporting country to the destination and the subsequent opportunities to spread once an organism has arrived. RE #6 is based on five separate components for each pathway. The cumulative score for the Likelihood of Introduction Risk Element is the Likelihood of Introduction Risk Score (numerical) which leads to a Likelihood of Introduction Risk Rating of low, medium or high.

RE #6: Entry Potential: Number of Potential Pathways and Likelihood of Survival in Each

The likelihood that an exotic weed will be introduced depends on the number of associated pathways and within each pathway, the weed's opportunity to survive and find a suitable habitat. For each pathway, consider five sub-elements, *i.e.*, consider the likelihood that the weed may:

1. Survive postharvest treatment (if no treatment, answer high, *i.e.*, >10%).
2. Survive shipment.
3. Not be detected at the port of entry (if no inspection, answer high, *i.e.*, >10%).
4. Imported or moved subsequently to an area with an environment suitable for survival.
5. Come into contact with suitable growing substrate or host material.

Likelihood Estimates for Risk Element #6.		
	Likelihood	Score
Low	= less than 0.1% = less than one in a thousand	1
Medium	= between 0.1% and 10% = between one in a thousand and one in ten	3
High	= greater than 10% = greater than one in ten	5

Identify the means by which the weed might enter the United States and estimate the likelihood of each pathway: For example, the weed being assessed might be identified as a contaminant of tall ryegrass, a possible hitchhiker in pineapple tops, and a species of interest medicinally or ornamentally. In the following table _A_ would be commercial tall ryegrass seed shipments, _B_ would be pineapples, _C_ would be passenger baggage.

Scoring for RE #6:

Pathway	Survive treatment	Survive shipment	Not be detected	Environment suitable for survival	Find host/growing substrate	Path total
A.	5	5	3	5	5	23
B.	5	5	1	5	1	17
C.	5	5	3	3	3	19
Total across pathways						59

Rate the Likelihood of Introduction using the Total across pathways above, as shown in the Table below:

Risk: Likelihood of Introduction (Sum across pathways, RE#6)

Cumulative pathway Score	Risk Rating	Risk Score
5 - 14	Low	1
15 - 24	Medium	2
25 or more	High	3

Total 5-14 = low likelihood of introduction

Total 15-24 = medium likelihood of introduction (minimum of 3 pathways, all low scores)

Total 25 or more = high likelihood of introduction (minimum of one pathway, all high scores)

Note: If the weed already has been introduced, the likelihood of introduction risk score is high, even if the pathway is unknown.

Step 7. Conclusion/Pest Risk Potential (PRP): Determine if Weed Should be Listed

Produce an estimate (PRP) of the risk by adding together the Consequences of Introduction Risk Score (1-3) and the Likelihood of Introduction Risk Score (1-3). Interpret the meaning of particular PRP values as follows:

Table 6. Pest Risk Potential

Score (Consequences of Introduction Score + Likelihood of Introduction Score)	Rating
2	Low
3 - 4	Medium
5 - 6	High

Although this document focuses on risk assessment (*i.e.*, FAO Stages 1 & 2), the risk assessor may comment briefly on the related issue of risk management (FAO Stage 3). For instance, weeds with a Consequences of Introduction rating of High will most likely be proposed for listing as Federal Noxious Weeds. Beyond this, the pest risk management phase is not discussed in this document. The risk assessor may comment regarding whether or not weeds ranked Medium should be officially controlled.

Step 8. Document the PRA. Cite references.

Consult the following sources (minimally):

A. Databases

National Agricultural Library's index, *Bibliography of Agriculture* (printed), or its electronic equivalent, *AGRICOLA* (database available on-line or on CD-ROM with coverage beginning in 1970).

Commonwealth Agriculture Bureaux International_s (CABI) printed abstracts (database available on-line or on CD-ROM with coverage beginning in 1972.)

The Germplasm Resources Information Network (GRIN) Database (Available on the web at <http://www.ars-grin.gov/npgs/tax/index.html>)

The Plant List of Accepted Nomenclature, Taxonomy, & Symbols (PLANTS) database. (Available on the world wide web at <http://plants.usda.gov/plants/qurymenu.html>)

B. Publications

Bailey, L.H. and Bailey, E.Z. 1976. *Hortus Third.*

Everett, T.H. 1981. *The New York Botanical Garden Illustrated Encyclopedia of Horticulture.*

Holm, L.G. et al. 1979. *A Geographic Atlas of World Weeds.*

Holm, L.G. et al 1977. *World_s Worst Weeds.*

Kartesz, J.T. 1994. *A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland.*

Reed, C.F. 1977. *Economically Important Foreign Weeds.*

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FAO. 1995. *International Standards for Phytosanitary Measures, Section 1_Import Regulations: Guidelines for Pest Risk Analysis.* Secretariat of the International Plant Protection Convention of the Food and Agriculture Organization (FAO) of the United Nations. Rome, 1995.

NAPPO. 1995. *NAPPO Compendium of Phytosanitary Terms*, B.E. Hopper, NAPPO Secretariat, ed. North American Plant Protection Organization (NAPPO), Nepean, Ontario, Canada.

U.S. Department of Agriculture (USDA). 1990. USDA plant hardiness zone map. USDA-Agricultural Research Service (ARS). Miscellaneous Publication Number 1475. USDA-ARS, Washington, DC 20002

USDA, APHIS. 1994. Weed Policy.

Acknowledgments

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